Photovoltaic System Design Software

Professional Software for the Design, Simulation and Optimization of PV Systems

Paul DeKleermaeker – N. American General Manager
Valentin Software, Inc.

Agenda

- Company Overview
- Products Offered
- The PV*SOL Model

Company Overview

- **Development of Design, Simulation and Modeling Software tools for Photovoltaic and Solar Heating Systems**
- **Established 1988**
- **50 employees (of which over 50% are engineers and developers)**

Global Headquarters:
Dr. Valentin EnergieSoftware GmbH
Berlin, Germany
www.valentin.de

North American Headquarters:
Valentin Software, Inc.
Carlsbad, CA (San Diego area)
www.valentin-software.com
info@valentin-software.com

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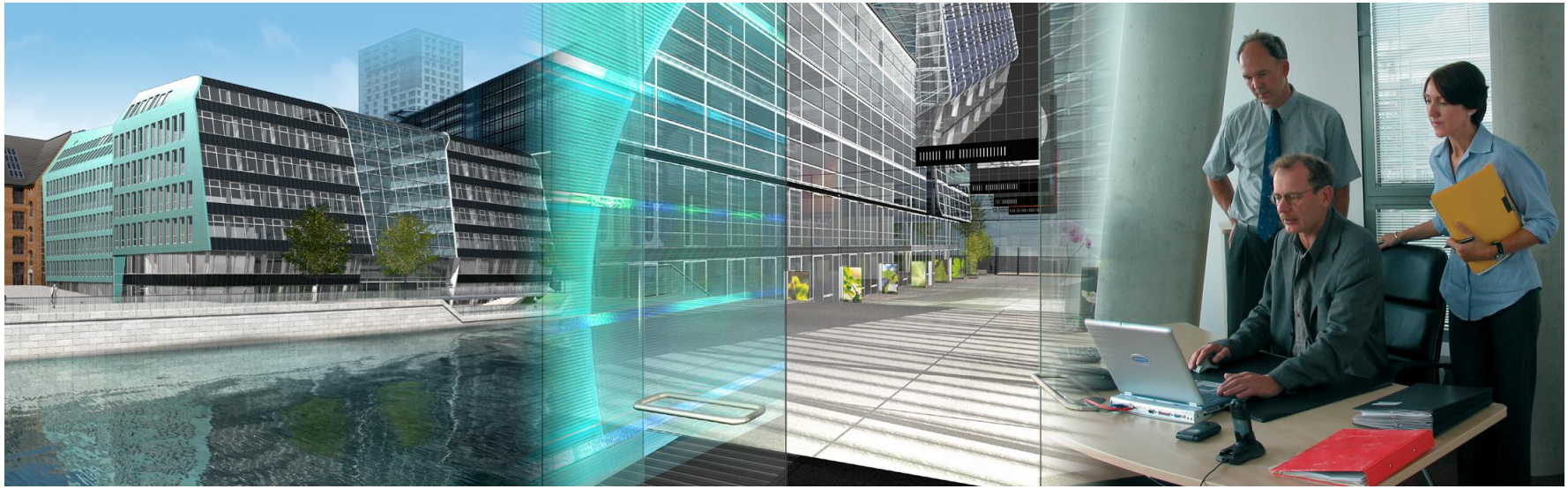
Our Team

Agenda

- Company Overview
- Products Offered
  - Standard Products
  - Company Specific Applications
- The PV*SOL Model

Business Areas



- Standard Software – *packaged solutions*
- Development of Company Specific Applications– *customized solutions*

Standard Software Families

A dynamic simulation program for the professional design and calculation of photovoltaic systems, including grid-connected, off-grid and battery backed-up systems.

A dynamic simulation program for the design and optimization of solar thermal systems, for applications including space heating, domestic hot water, pools and industrial usage.

Different Levels of Software for Different Levels of Users

- Expert version
- Professional version
- basic version
- Online calculator

PV*SOL basic

PV*SOL basic

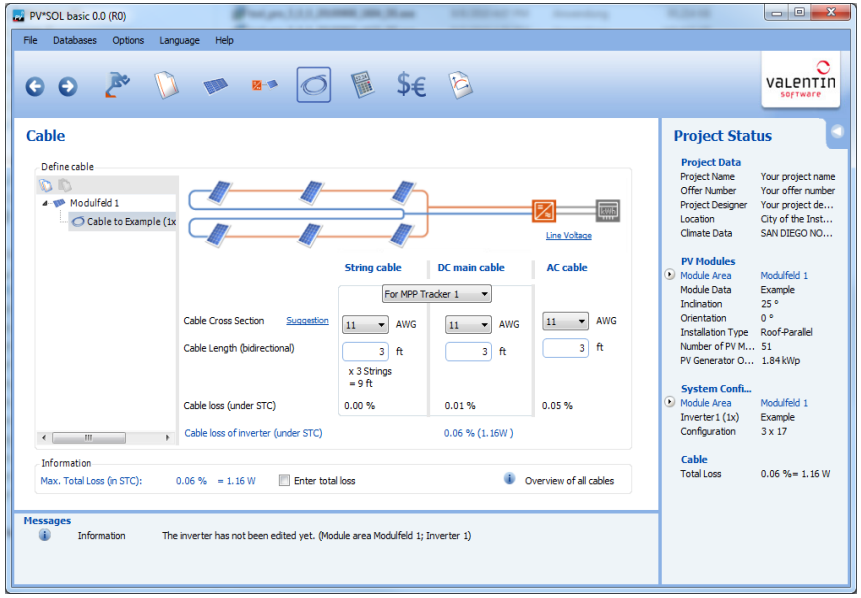
Residential and commercial grid-connected systems, up to 1,000 modules

Automatic inverter selection and configuration

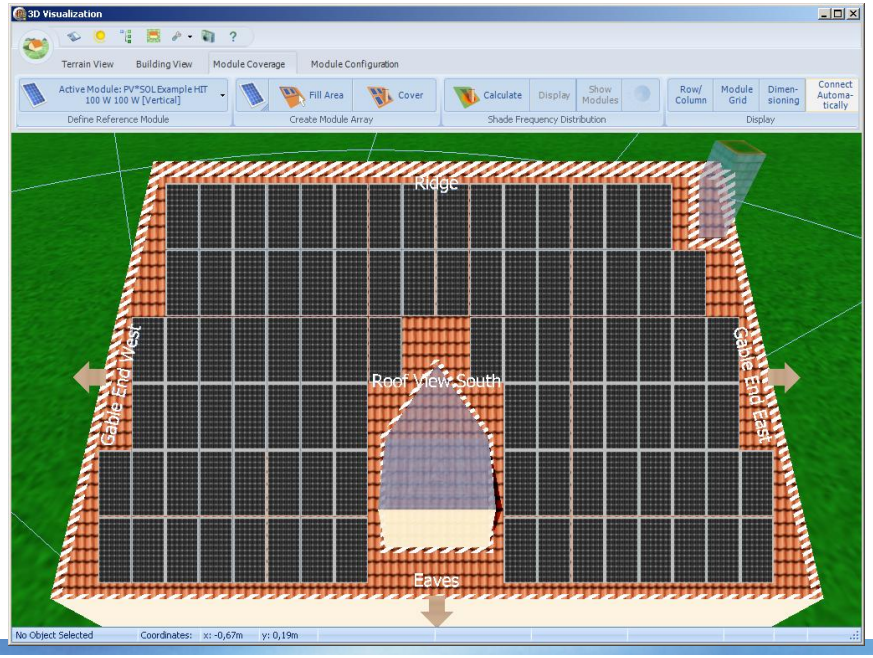
Roof layout

Incentive rates and energy tariffs

Wire size calculation and losses



PV*SOL Pro



PV*SOL Pro

Residential, commercial and power plant systems up to approx. 100MWp

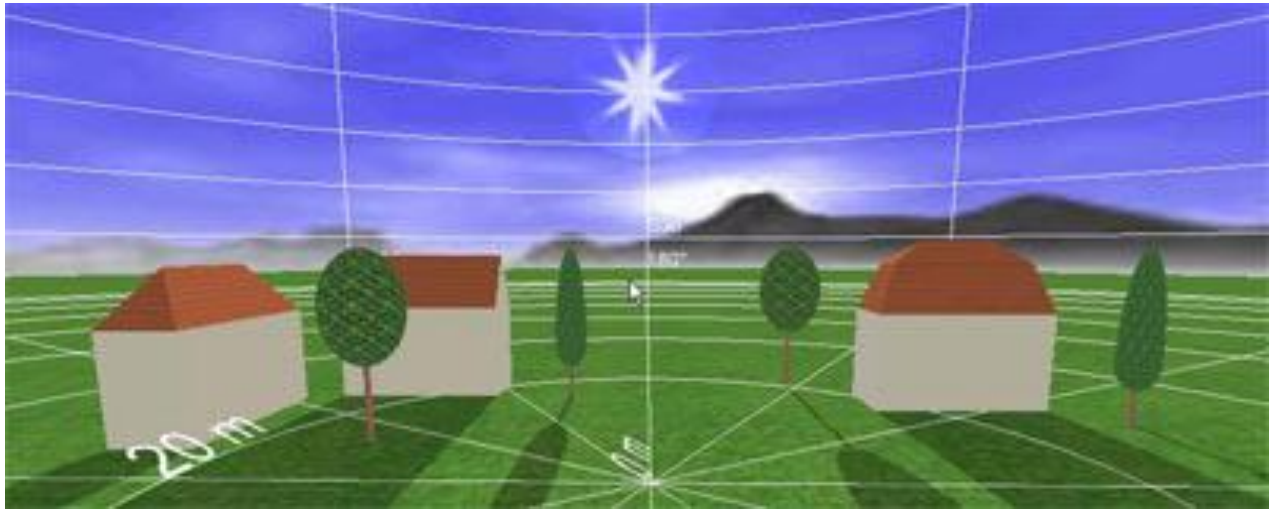
Grid-connected and off-grid

2D shade analysis

PV*SOL Expert

PV*SOL Expert

3D Visualization plus all the capabilities and features of PV*SOL Pro



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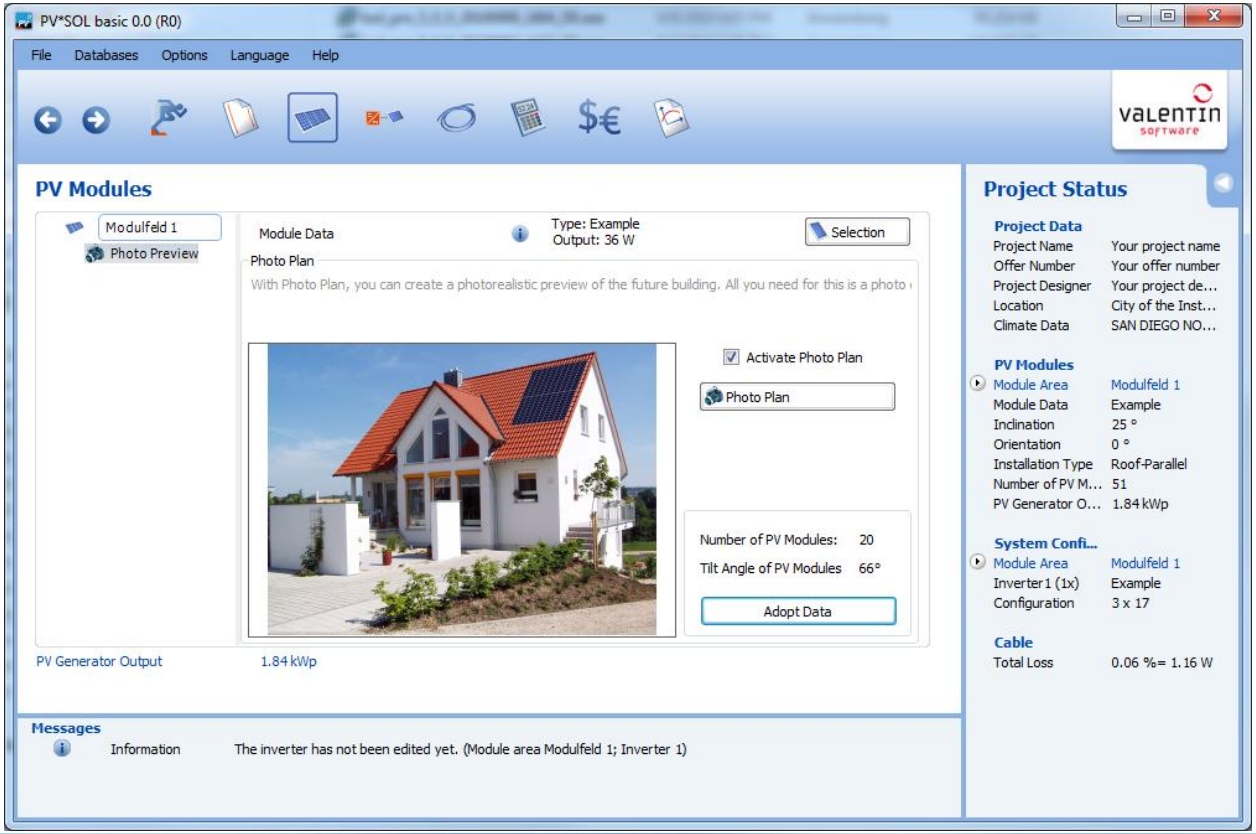
PhotoPlan



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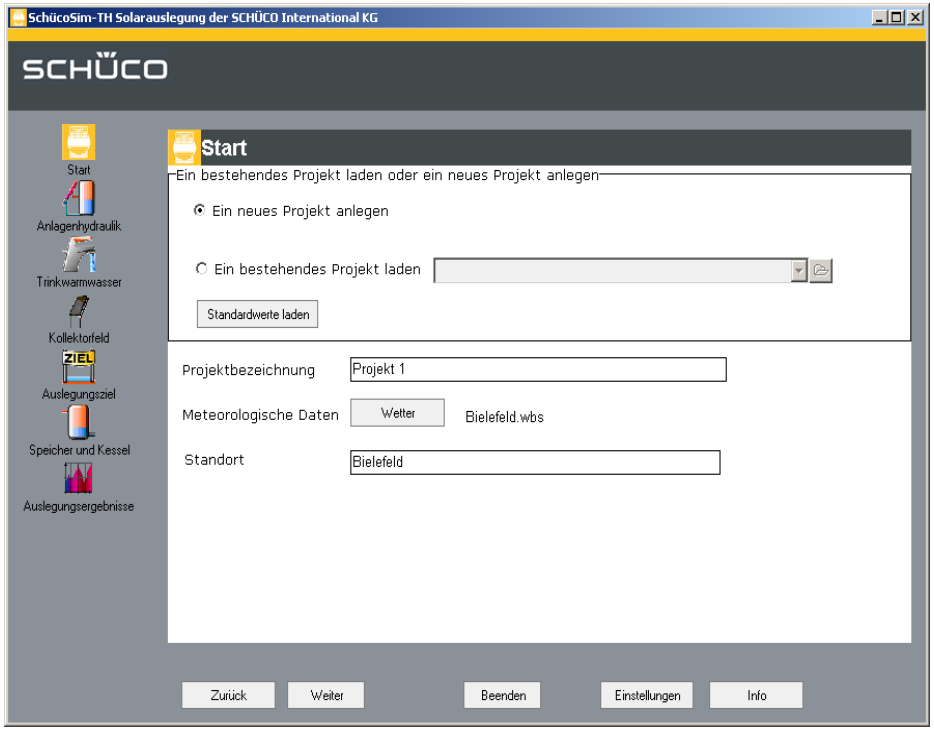
PhotoPlan Output

Company Specific Applications

Customized Programs based on **T*SOL express or PV*SOL basic**



- Individual look
- Specific Components
- Design
- Parts List
- End-user Proposals

Input

- Location for Meteorological Data
- Consumption Profile
- Module Modeling
- Inverter Modeling
- Array Layout
- Losses
- Tariffs

Output

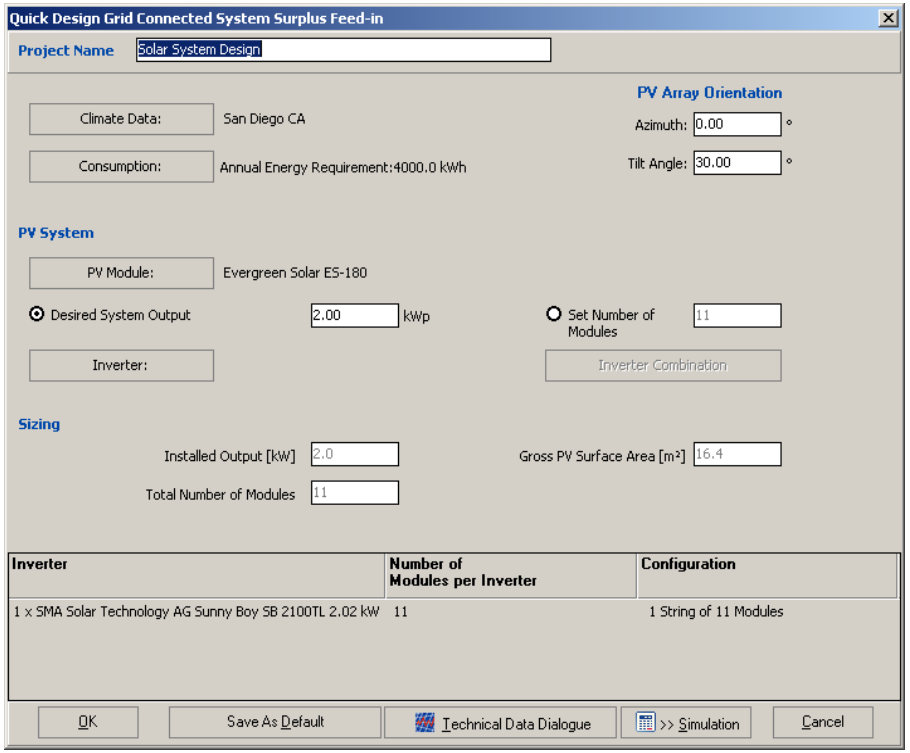
- Energy Balance
- Final Yield
- Efficiency
- Detailed System Data
- Array Layout
- Economic Payback
- Return on Investment

Developed for wide Market Acceptance

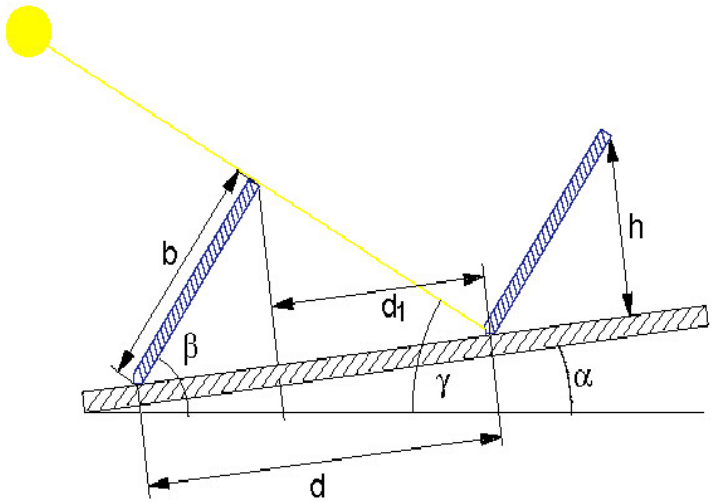
- Robust, proven, stable – customers in over 70 countries, over 70% of installed systems in Germany in 2009 were designed and modeled using PV*SOL.

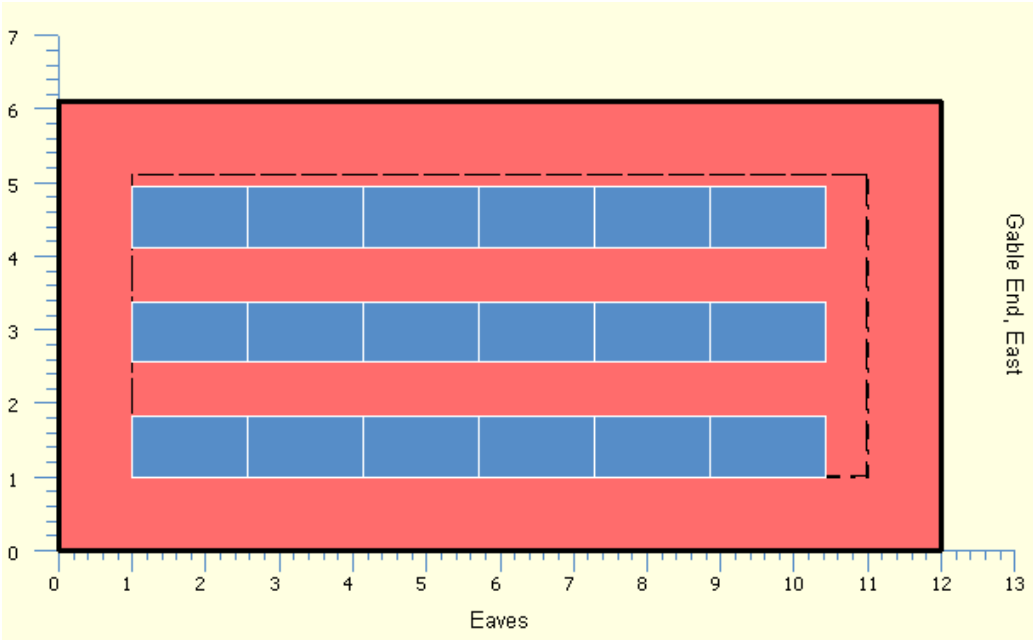
- Developed for designers, installers, project engineers and developers

- Easy to use: Design assistants, intuitive interface and design flow



Roof Parameters and Row Spacing





Agenda

- Company Overview
- ProductsOffered
- PV*SOL Model

PV*SOL Model

Module Model

- Incident Angle Modifier for reflection
- Module Efficiency Curve for MPP
  - Calculated for all irradiation levels, requires additional partial load operation point
- Complete IV-characteristics for non-MPP operation points
- Efficiency and IV-curves are module temperature corrected
  - 3 temperature coefficients: voltage, current, MPP
- Linear or dynamic temperature model options

PV*SOL Model

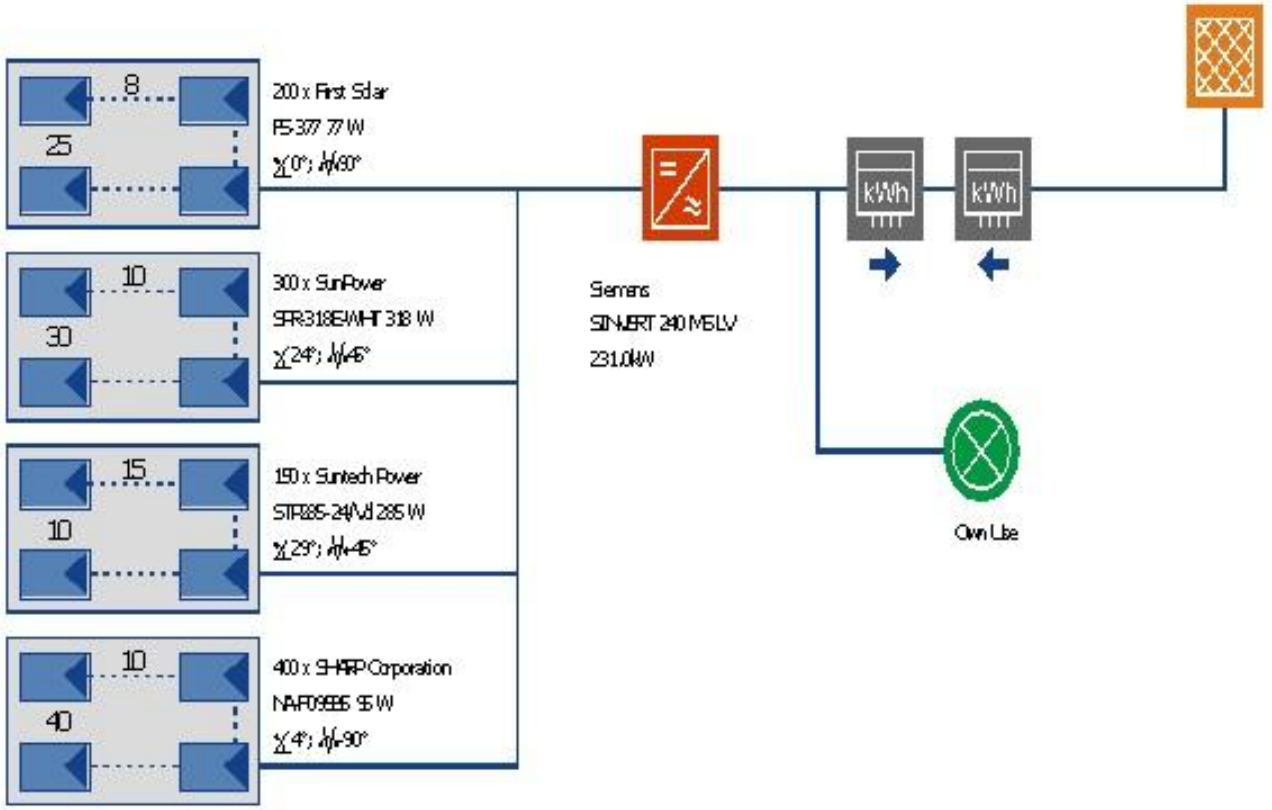
Module Technologies

- cSi, aSi, CdTe, CIS, HIT, µc-Si, Ribbon
- Models each technology's unique characteristics
- Standard data sets for each technology

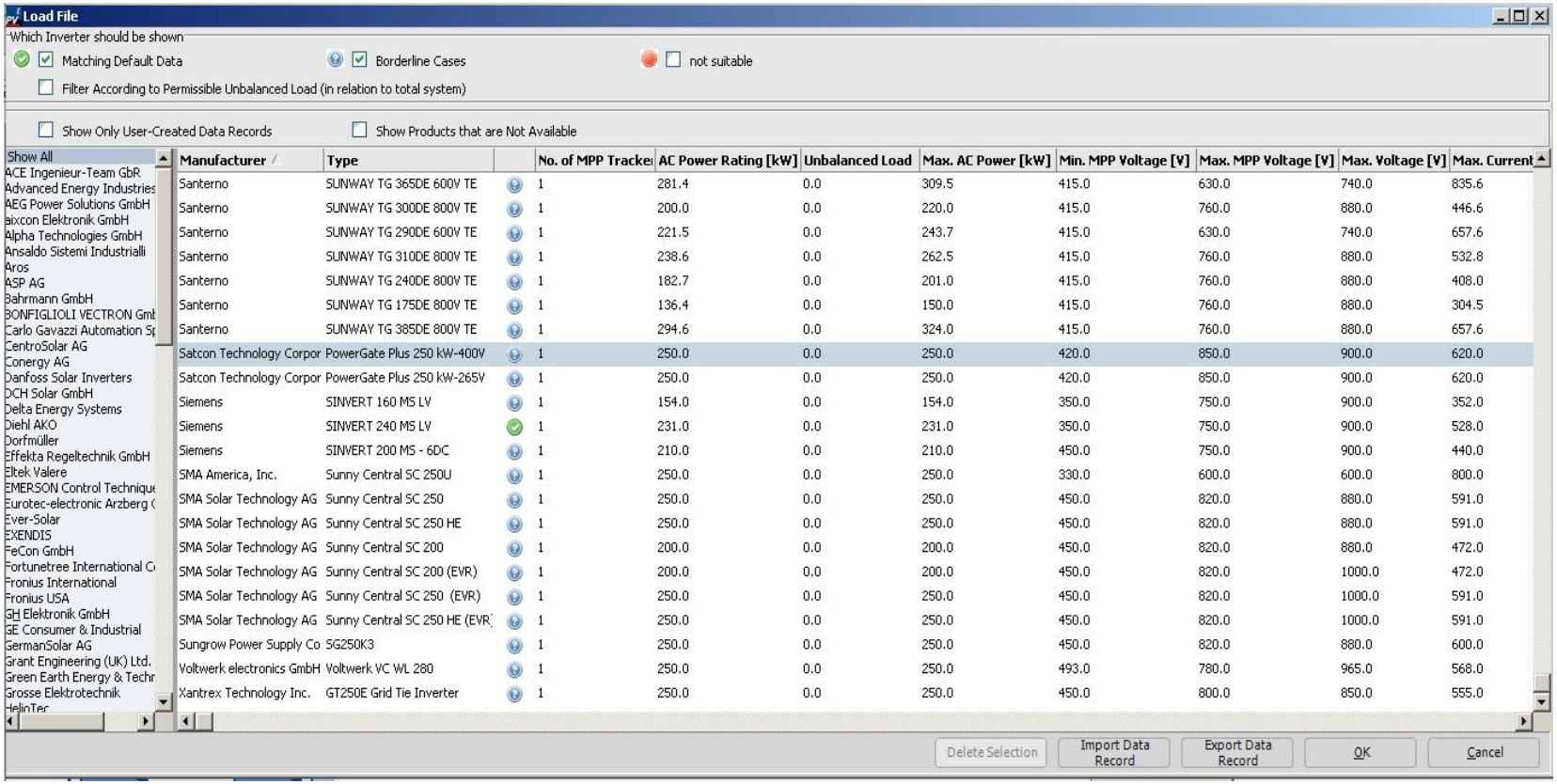
PV*SOL Model

Inverter Model	• Inverter profile and efficiency curve • Voltage dependent correction • Ability to model multiple inverters (quantity and type)
Configuration and Automatic Inverter Optimization	• One inverter for multiple sub-arrays with different sizes, modules and orientations • Multiple types of inverters in one system • Automatic selection of appropriate configurations • Automatic inverter sizing and selection
Simulation Frequency	• In hourly increments • Shade calculated in 10-minute intervals

Diverse Flexibility in Array Design: Mix Technologies, Orientation & Configurations



Inverter Selection: 1 Inverter, 4 Arrays



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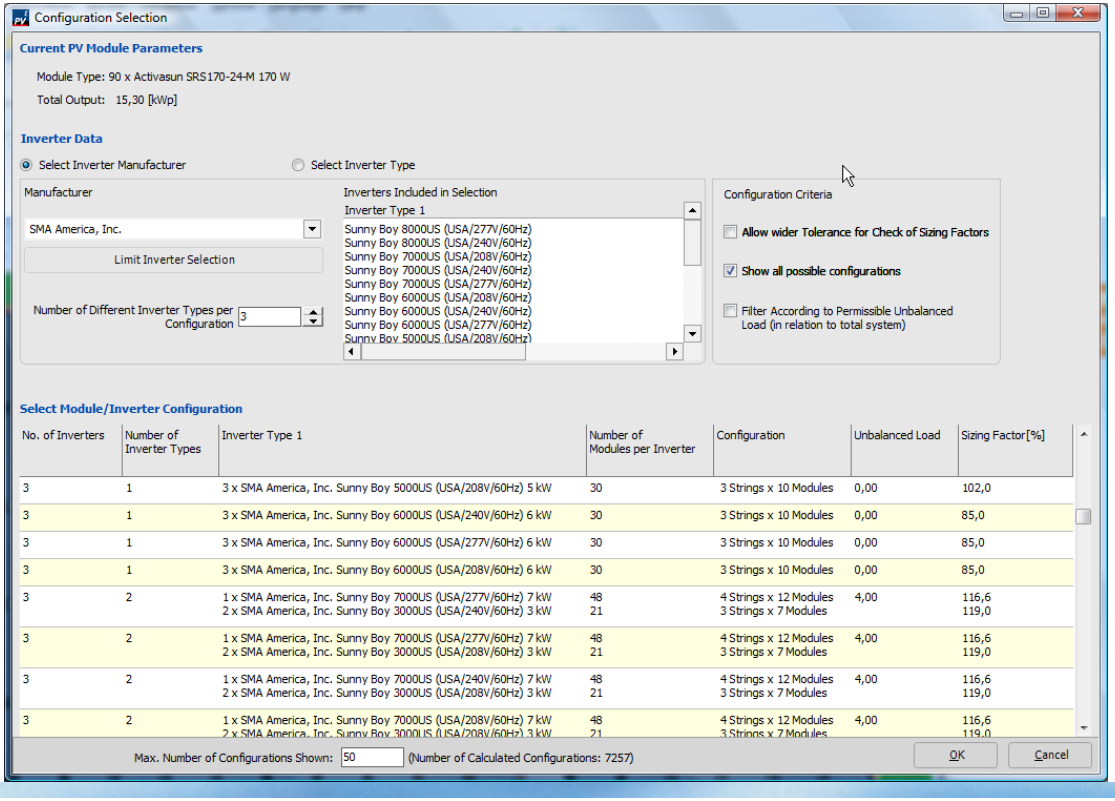
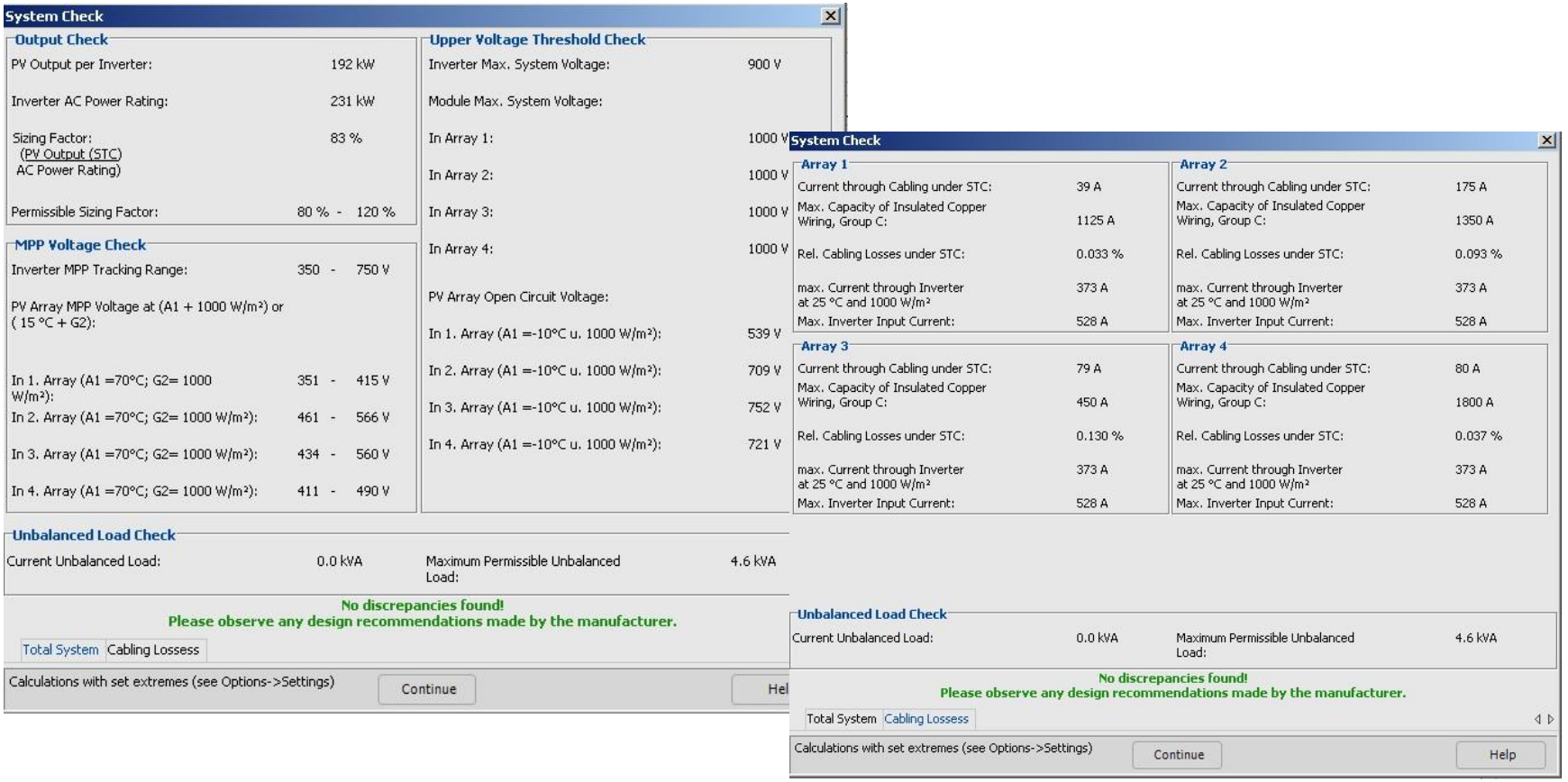
valentin software

Inverter Selection: Multiple and Different Inverters allowed



System Check before Simulation



PV*SOL Model - Climate

Weather Data Source

- MeteoSyn, Meteonorm, TMY3, SWERA, PVGIS, NASA-SSE, user import and create

Irradiance Model

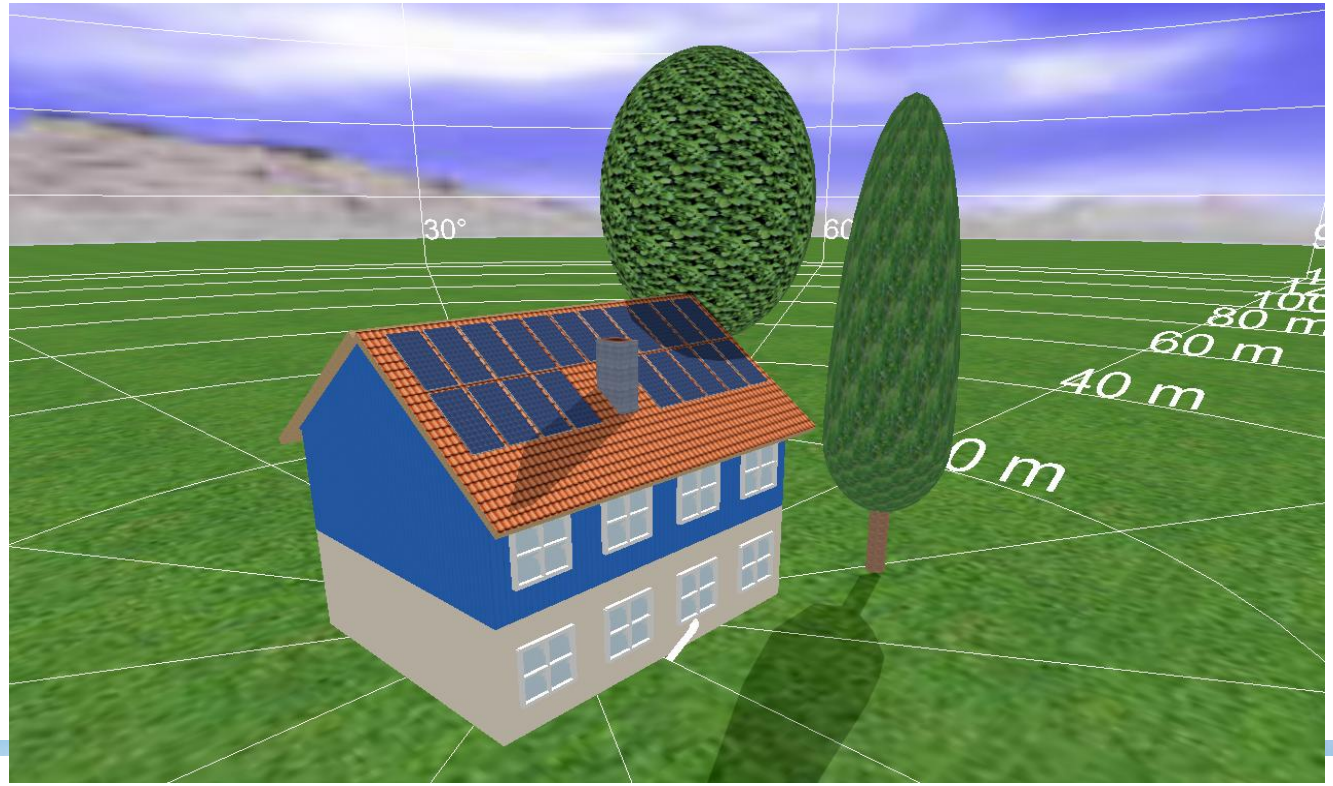
- Hay and Davies model
- Albedo - monthly

PV*SOL Model - Shading

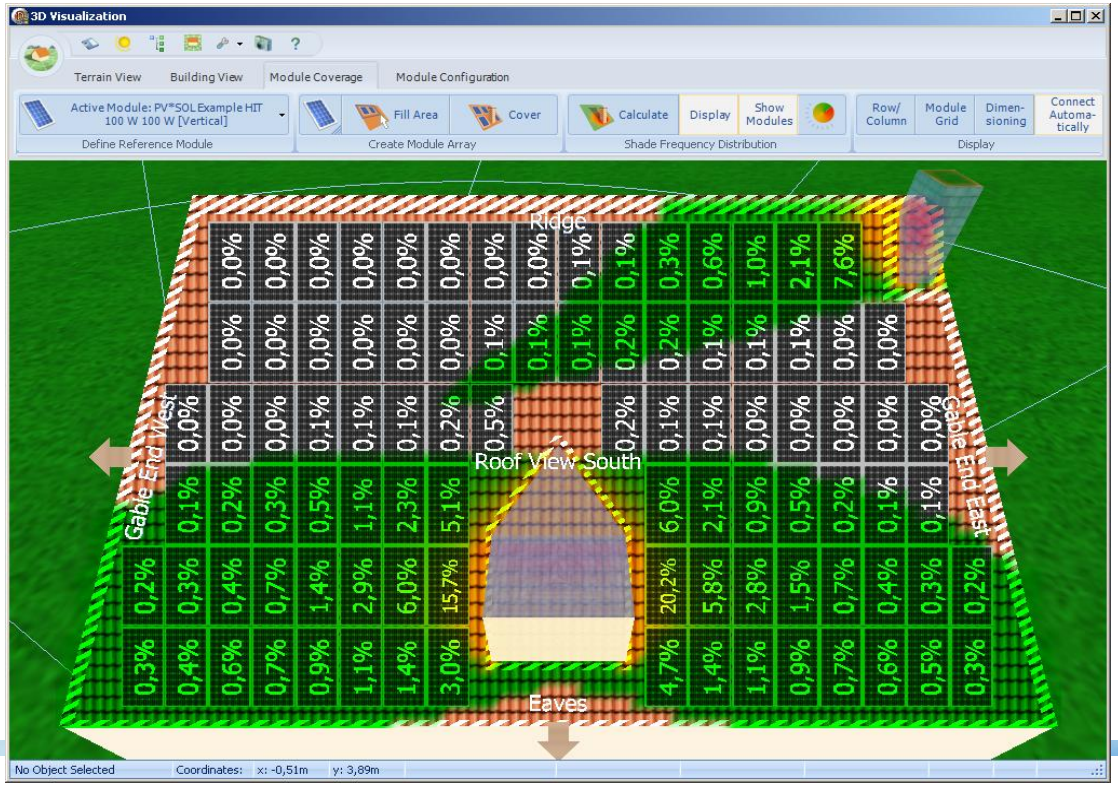
Shading

- Horizon based
  - user-defined or imported
- 3D Model
  - Area based
  - Models near and horizon shade in 10 minute intervals
  - Calculates impact per string of cells within each module

PV*SOL Expert 3D Visualization



Shade Analysis and Degradation



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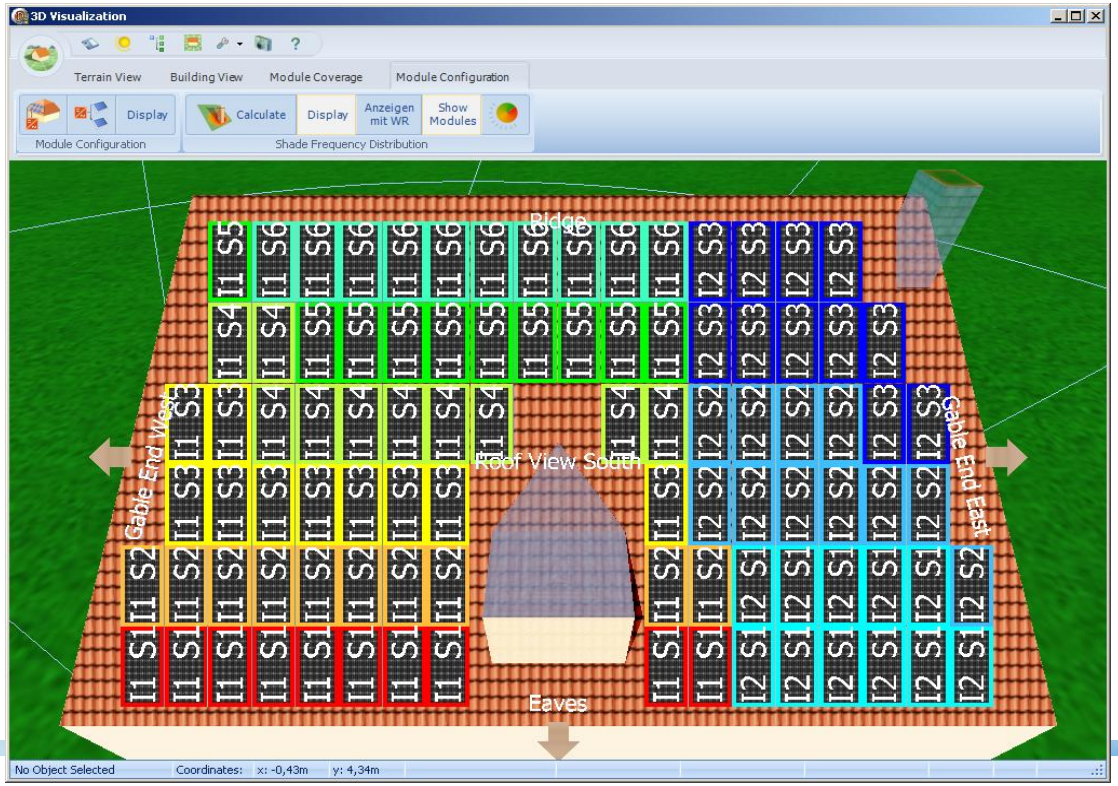
String Optimization



PV*SOL Model - Losses

Losses & Derate Parameters

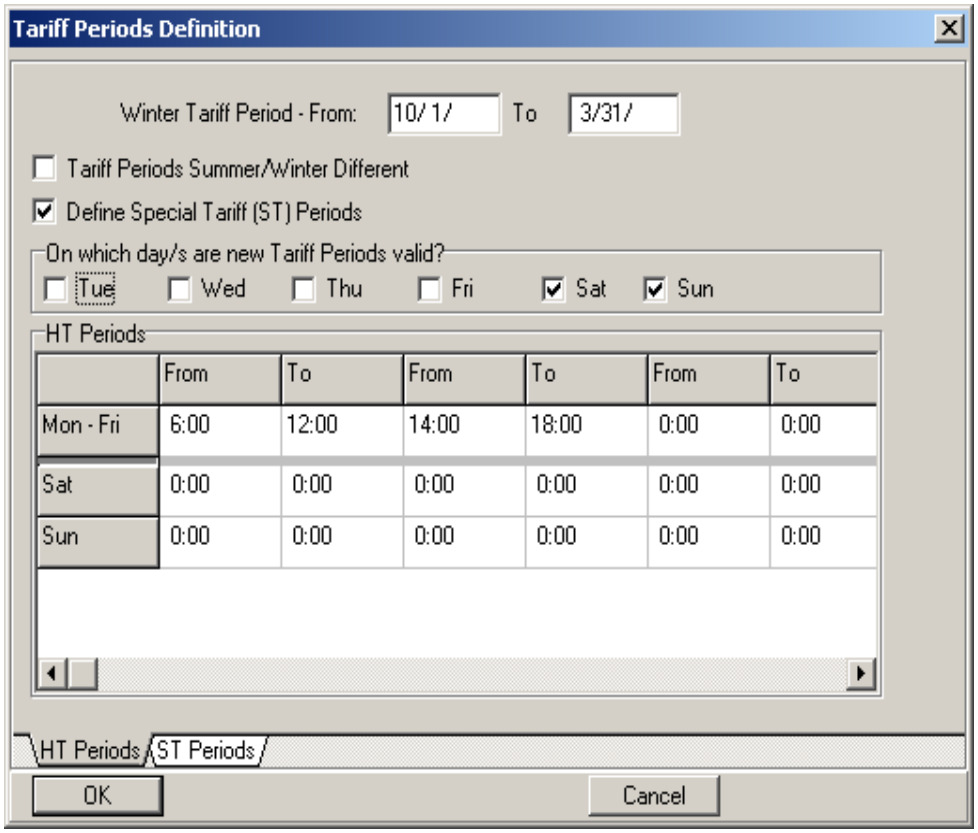
- Module mismatch, diodes & module quality
- Wiring – calculated from cable data
- Deviation from standard spectrum
- Soiling

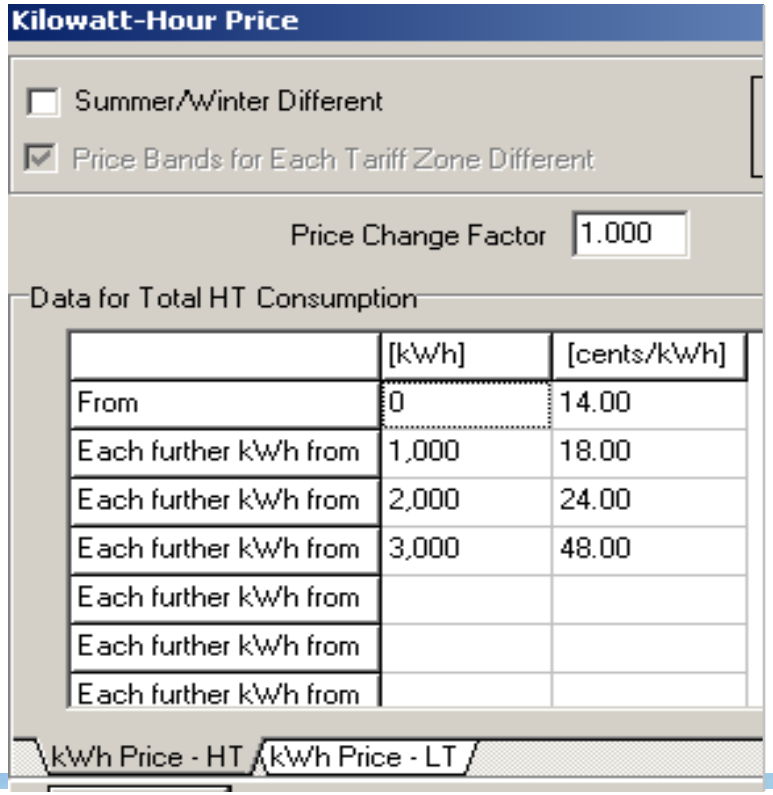
PV*SOL Model – Financial Analysis

System Financials

- Economic efficiency and cash-flow analysis
- User defined complex tariffs and incentives
- Loans

User Defined Tariff Rates





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PV*SOL basic 0.0 (R0)

File Databases Options Language Help

Financial Analysis

Type of project: (•) Residential ( ) Commercial

System costs

Total installed system cost	33392	€	[x] Payed	Specify loan	
Yearly operation and maintainance cost	200	€/year	Expected system life	25	years
Inverter replacement cost	1800	€	Due every	15	years

Consumption

Utility: Imperial Irrigation District

Utility rate: D- Residential Service

(•) Annual electricity bill 3600 € ( ) Monthly load Insert

Yearly increase of energy costs 4 %

Estimate with Home Energy Saver

Information relevant for incentives selection

Yearly income 65000 €

Tax status: household head

[ ] Choose second option of incentives where appliable.

Messages

Information: The inverter has not been edited yet. (module area Your Module Area; inverter 1)

Project Status

Project Data

Project Name	A new residenti...
Proposal Number	Your proposal n...
Project Designer	Your project de...
Project Location	Ihr Projektstan...
Climate Data	San Diego Ca

PV Modules

Module Area	Your Module Area
Module Data	Example
Tilt	25 °
Orientation	0 °
Mounting Type	Roof-Parallel
Number of PV M...	51
PV System DC ...	1,84 kWp

System Confi...

Module Area	Your Module Area
Inverter1 (1x)	Example
Configuration	3 x 17

Cable

Total Loss	0,37%= 6,79 W

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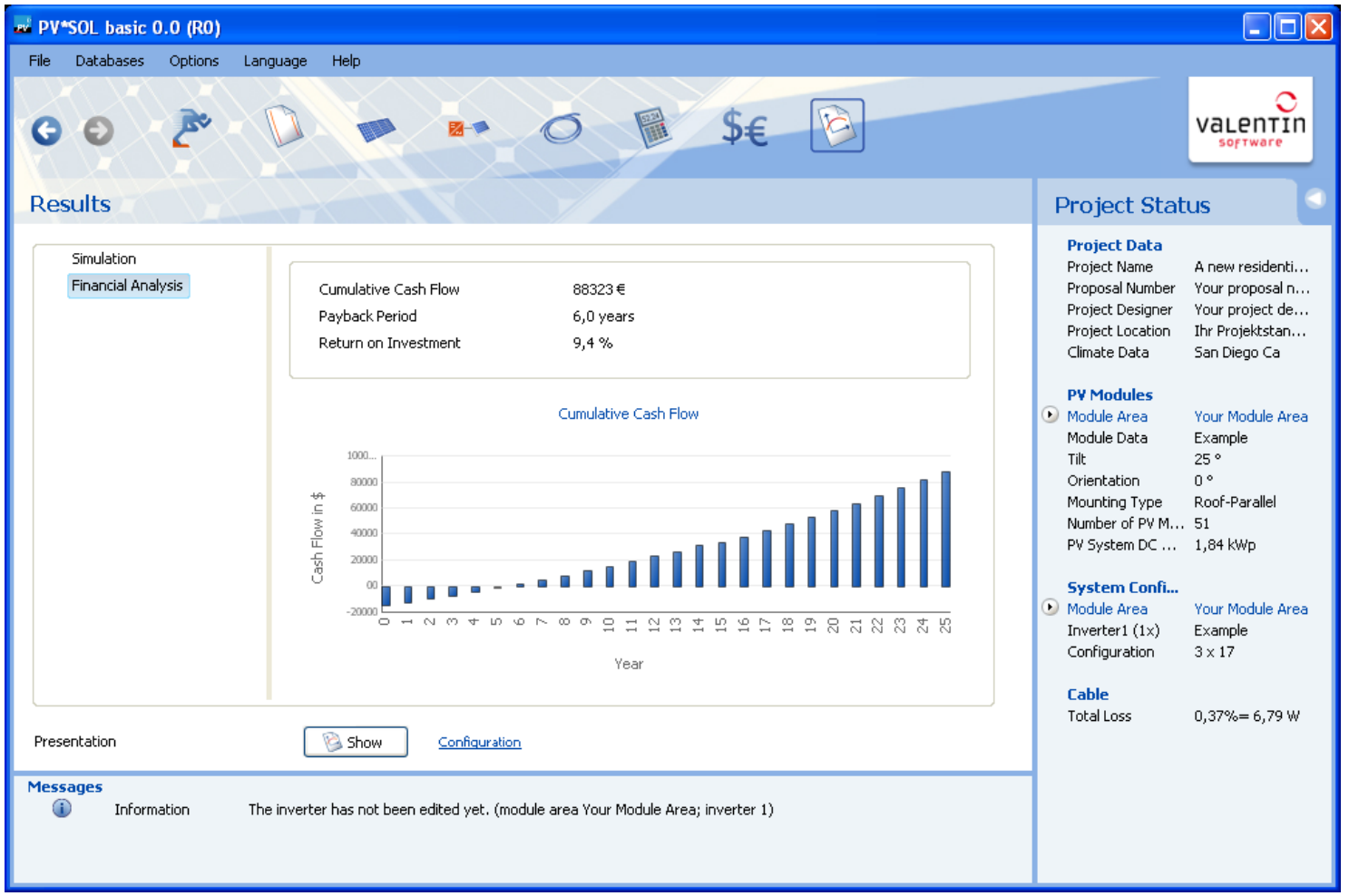


PV*SOL Model – Project Results

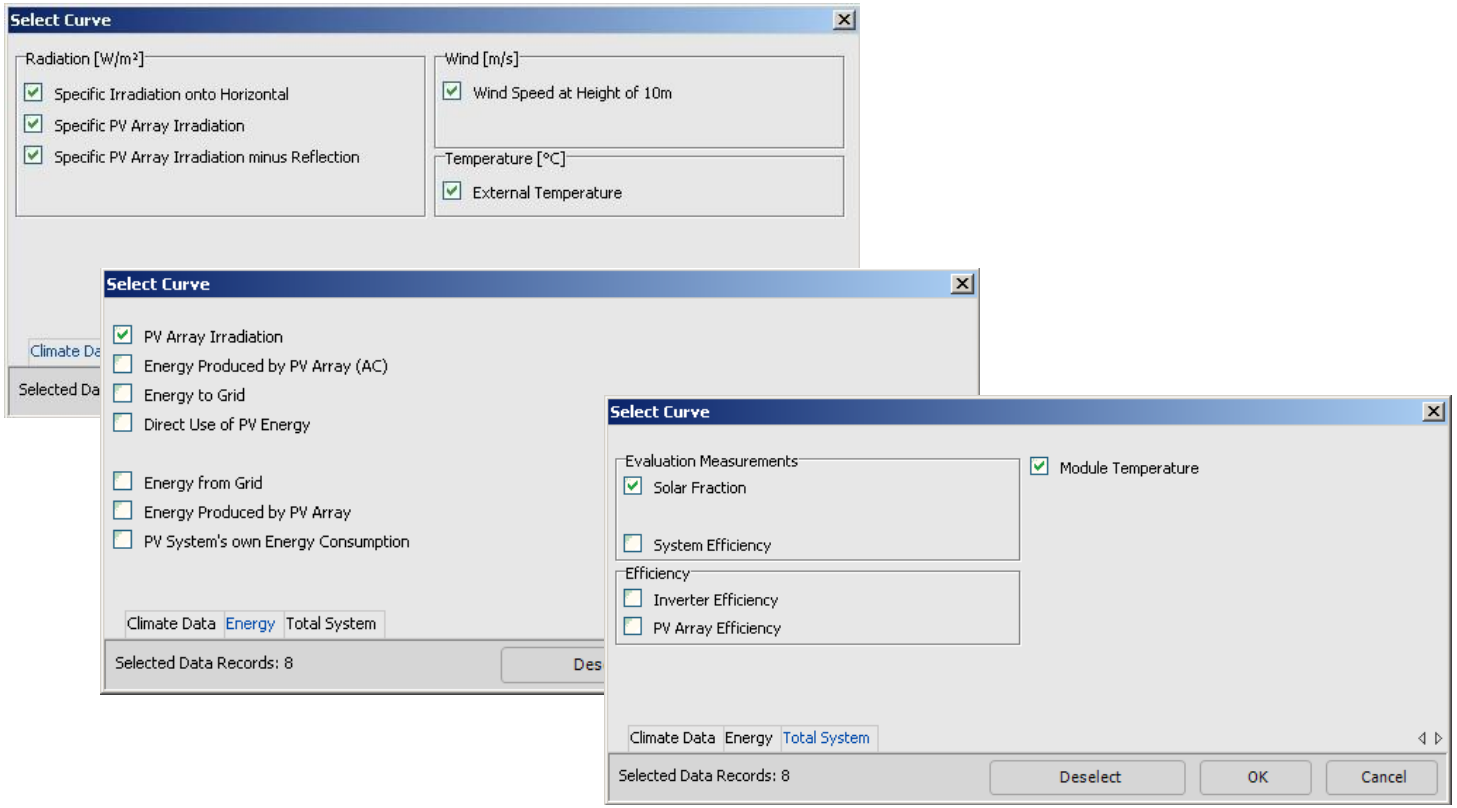
Report

- Location, climate data, equipment, load, array, inverter, production, loses
- Array layout
- 3D Views or photo realistic
- Financial Analysis

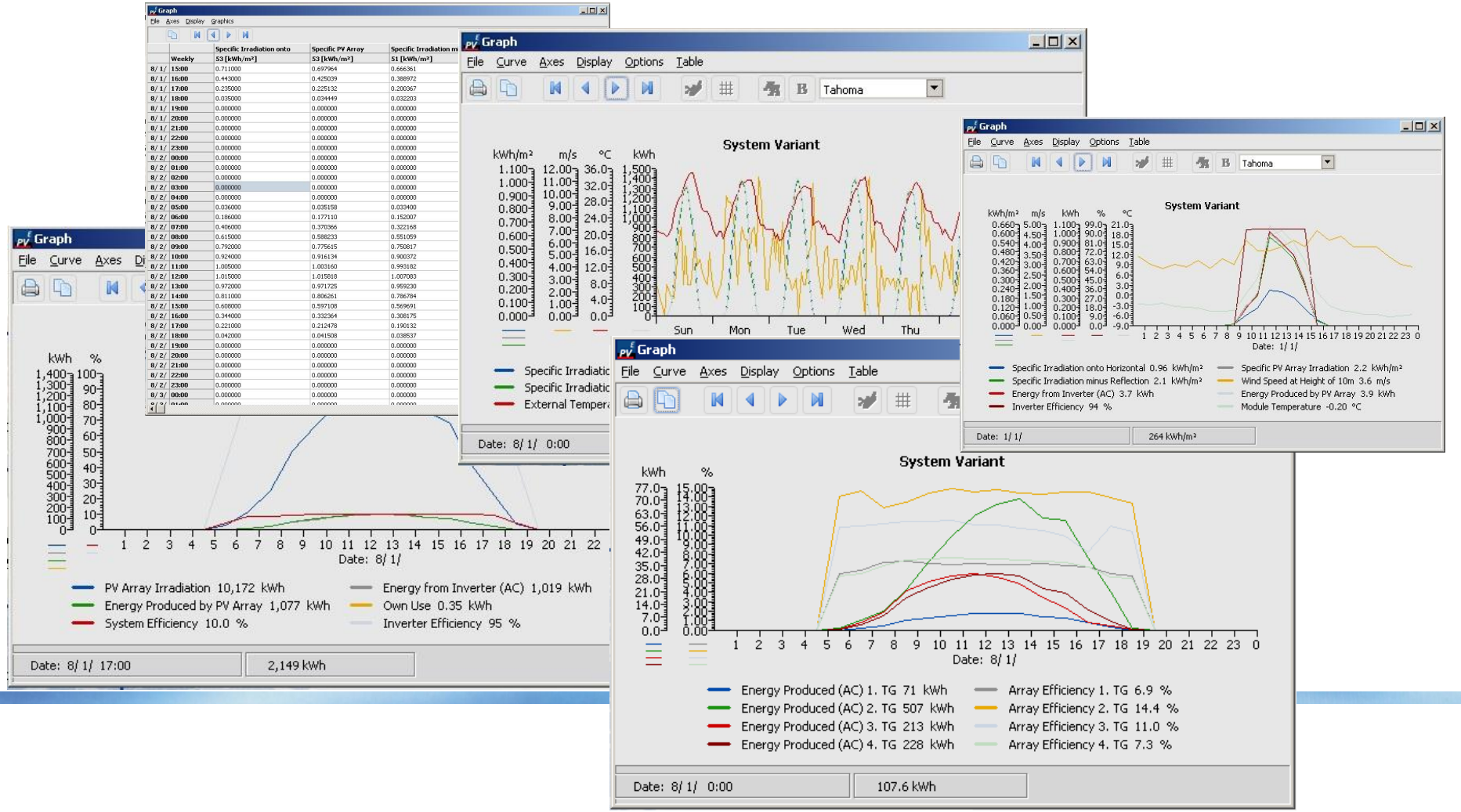
Output options

- Graphical
- Table format
- Export, copy/paste
- .pdf

Output Options



Detailed Reporting Options



PV*SOL Model - Databases

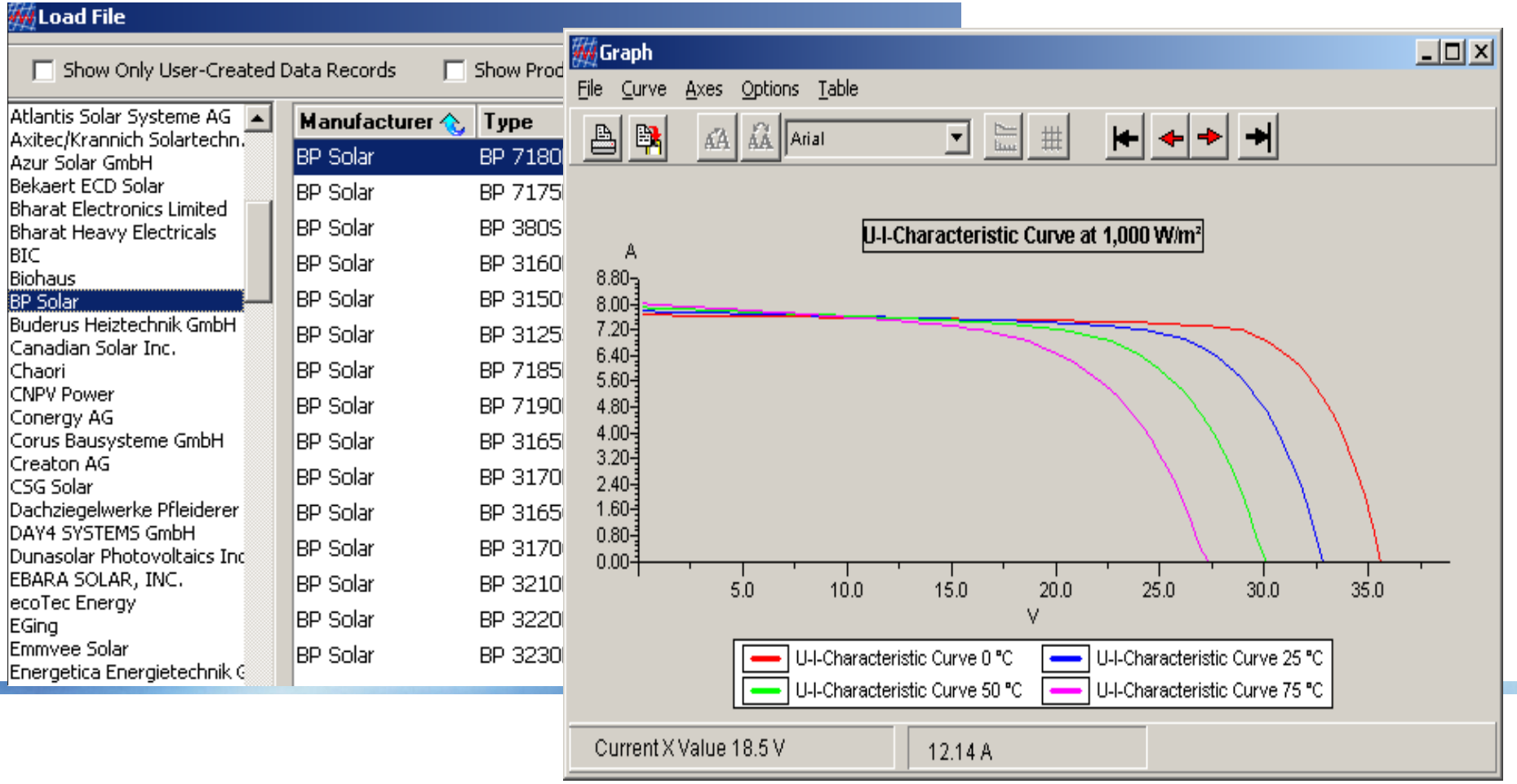
Component

- Over 5,000 modules
- Over 1,200 inverters
- User can create or modify
- Automatic updates via internet, distributed ~ weekly

Climate

- 1,020 US TMY3 locations
- 8,000 global locations
- User can create and import

Module Database



Download Free Demo Software

Free demo software of both PV*SOL and T*SOL are available at:

www.valentin-software.com

Thank You for Your Attention

Standalone System in Nepal

Designed by PV*SOL